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those already described, there arose the appearance of a compromise between a bird's wing and an insect's wing; and with this appearance the whole activity seemed to subside and the psychical-complex, the psychosis, now regained its normal state. There seemed now no incentive to stir it further.

Models were constructed from designs conceived in these latter activities, and although thirty-five years have since elapsed the writer has never been able to improve upon these designs.

E. A. NORRIS.

ALBANY, N. Y.

MEMORY TYPES OF COLORADO PUPILS

IN connection with the work in educational psychology and child study in the Colorado State Normal School during the past year, studies have been made of the memory types and memory spans of both normal school and training school pupils, the results of which, while revealing nothing wholly new, may be valuable for purposes of comparison or as hints for further investigations. The subjects of the investigation were 100 boys and 154 girls of the training school, distributed through the grades from three to eleven, inclusive, and some 300 juniors, mostly girls, in the normal school.

I. *The Tests.* The tests were those used by Smedley,[1] with some modifications, which are apparent in the descriptions. Five sets of ten cards each were prepared, one set for each test. The cards were of dark gray cardboard, 3.5 inches wide by 18 inches long. On each card a number was printed in white digits 2.5 inches high and 2 inches wide, the numbers ranging from four digits to eight digits, and two numbers of each length constituting one set of test cards. In the arrangement of the nine significant digits to form the numbers, care was taken to avoid familiar sequences, thus minimizing the number of natural associations among the digits. The object was to discover what differences, if any, existed in the students' ability to remember combinations of digits when the stimulus was purely auditory, purely visual, or audio-visual, audio-visual-articulatory and audio-visual-articulatory-hand-motor—to use Smedley's terms.

II. *The Method.* A different set of cards was used for each test. To regulate the rate of reading the digits in the auditory test and to determine the length of exposure of the card in the other tests, a metronome beating 72 times per minute was used. One beat was allowed for each digit in the number exposed, and five seconds elapsed between the end of the exposure and the writing of the number from memory. In the auditory test the number was read aloud distinctly and without rhythm to the beating of the metronome. In the visual test the card was exposed in easy view of the pupils for a period determined by the length of the number—five sixths of a second for each digit. In the audio-visual test the number was read aloud while the pupils were regarding it, the rate of reading and length of exposure being determined as in the first two tests. For the audio-visual-articulatory experiment the pupils read the number on the exposed card aloud and in concert. Our final test of the five differed from Smedley's in that we included in the stimulus the articulatory element which he omitted: he had his subjects write down the numbers from dictation, and later reproduce them; our subjects read the numbers from the exposed cards in concert, as in the articulatory test, and at the same time wrote them with the blunt ends of their pencils.

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[1] See the Chicago report, No. 3, of the Department of Child Study and Pedagogic Investigation, 1900–1901, pp. 43–60.

Since the numbers of each set of cards aggregate 60 digits, the computation of the per cent. of error was an easy matter. One error was scored for each digit misplaced, substituted, omitted or inserted.

III. *Results in the Grades.* 1. The memory span—determined as in Smedley's report (pp. 52, 53)—for auditory memory was found to be four digits for the third grade, five digits for grades four to seven, inclusive, and six digits for grades eight, nine, ten and eleven;[2] for visual memory the span is five digits in grade three, six in the next three grades and seven in the highest four grades. These averages seem slightly below those of the Chicago children of Smedley's test, though his computations were on the basis of age rather than grade.

2. This study gives no evidence of a special memory period. Every type of sense memory improves steadily through the ages covered by the investigation, although auditory memory has attained almost its maximum by the age of fifteen.

3. Auditory memory is distinctly inferior to every other type here studied, in every grade and at every age (eight to twenty-one). Its curve runs from 5 per cent. to 15 per cent. below the others. Smedley found auditory memory superior to visual until the age of nine.

4. There is very little difference in sense-memory of the other four types. While they all improve as we ascend the grades, their curves all lie within a zone which averages not more than five per cent. in width as platted on the familiar gridiron. The articulatory and hand-motor curves are slightly above the visual and audio-visual curves at most ages.

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[2] The high school is organized in three grades.

5. Among the subjects of this study beyond the age of fifteen, the boys show a decided superiority to the girls in every type of memory tested. Below fifteen there is no apparent sex difference, except that girls average about 5 per cent. better than boys in audio-visual-articulatory memory throughout. In one class of 166 normal school juniors the boys graded from 3 per cent. to 9 per cent. better than the girls in every test. In another class of the same rank, numbering about 140, the boys excelled the girls in every type of memory except the articulatory and hand-motor. In both these classes, however, the proportion of boys was too small to afford a safe basis for generalization.

6. Generally speaking, the better students in each grade exhibited better ability to remember than the poorer ones, though the contrast is not nearly so marked or so constant as in Smedley's results, and there are so many individual exceptions that one is forced to question somewhat the value of the generalization. The chief superiority of the good students lies in the articulatory and the hand-motor types.

7. The most striking and decided conclusions of this study arose from a comparison of the abilities in sense memory of pupils of the same age found in different grades. Fifteen-year-old pupils were selected because they were found to be most widely distributed, ranging from the sixth to the eleventh grade. While there were but thirty-seven of these pupils, quite evenly distributed as to grades, their papers brought out a very regular but decided improvement in every form of memory, except the auditory, with school advancement. To give exact figures—auditory memory improves only 1.5 per cent. from 67.5 per cent. in the sixth grade to 69 per cent. in grade eleven; visual, from 68.5 per cent. in the sixth grade to 87 per cent. in the eleventh; audio-visual-articulatory, from 74 per cent. to 88 per cent. in the same interval; audio-visual-articulatory-hand-motor, from 69 per cent. to 95 per cent. If it were safe to generalize from such limited data, we should be forced to conclude that memory power is a matter of general mental development rather than of age, and further that articulatory and hand-motor memory are types most characteristic of the more advanced students.

IV. *Further Results from Older Subjects.* 1. For auditory memory the span of normal school juniors was found to be seven digits; for visual, eight digits.

2. The averages of a class of 166 juniors are typical of the results obtained from all the older subjects tested. They are as follows: auditory, 76.4 per cent.; visual, 84.4 per cent.; audio-visual, 90 per cent.; audio-visual-articulatory, 92.1 per cent.; audio-visual-articulatory-hand-motor, 92.9 per cent. These figures seem to indicate that for mature students that is best remembered which makes its

appeal through the greatest number of sense channels—a belief which is by no means new.

3. After all the above tests had been completed, in order to discover whether the superiority of the later-tested types of memory might be due to any extent to practise, a second auditory test was given which resulted, for the 166 juniors, in an average of 85.3 per cent.; an improvement over the first auditory test of nearly 9 per cent., but still below all other types.

4. To test the effect of repetition on memory, the last-mentioned auditory test was followed immediately by another in which the numbers were twice repeated after the first reading; this yielded an average of 92.2 per cent. A third auditory experiment was then given in which the numbers were repeated but once after the first reading; the average for this test was 90.4 per cent. The figures are self-explanatory.

WILL GRANT CHAMBERS.

COLORADO STATE NORMAL SCHOOL.

DISCUSSION

THOUGHT AND IMMEDIACY

THE point raised by Professor Bakewell in his comments on Professor Dewey's account of Immediatism[1] seems to me to be so interesting and so vital to the epistemological controversy of the day as to deserve further elucidation and discussion, even after Professor Dewey's admirable replies, with which, so far as they go, I am happy to find myself in cordial agreement.

But though Professor Dewey entirely succeeds, to my thinking, in upholding his own point of view, he does not attempt to account for the genesis of what we both consider an error, or to explain how very natural and plausible Professor Bakewell's contention is bound to appear from certain presuppositions. It seems worth while, therefore, to examine it more closely and to exhibit the underlying confusion from which it seems to arise. For so long as this confusion is allowed to persist, it is impossible to understand the plain meaning of immediatism, or to appreciate the position of Professor Dewey, against which baseless accusations of inconsistency are therefore bound to spring up.

Professor Bakewell generously disclaims, on behalf of 'the idealist' in general, what I fear can be true only of his own particular school of idealism, *viz.*, any desire to despise experience, assuring us

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[1] See this JOURNAL, Vol. II., Nos. 19, 22, 25, 26.